

## ***North Dakota Phosphorus Risk Assessment***

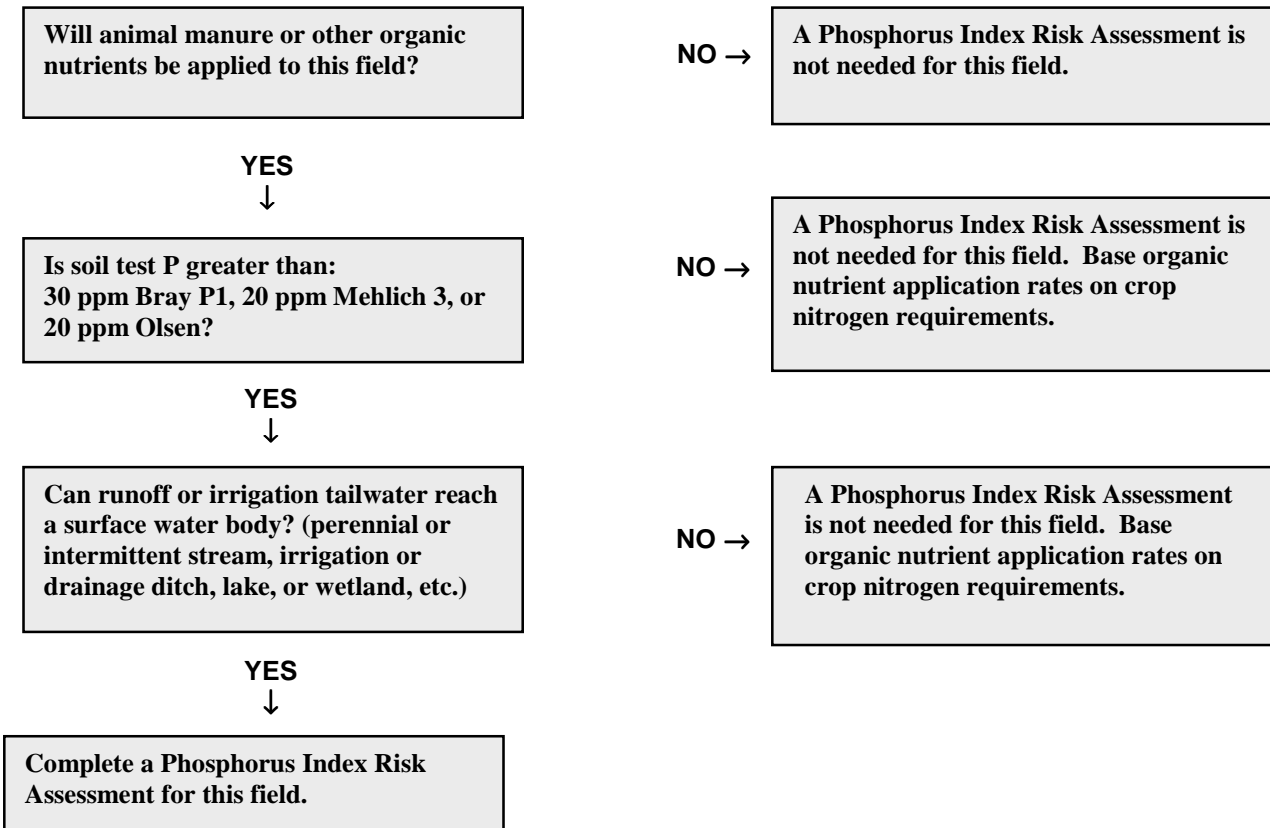
A North Dakota Phosphorus Risk Assessment Process has been developed in cooperation with North Dakota State University Extension Service and North Dakota Department of Health to comply with the revised Natural Resources Conservation Service Nutrient Management Policy and Nutrient Management Conservation Practice Standard, Code 590. According to the revised policy and standard, a field-by-field risk assessment of the potential for phosphorus transport shall be completed for **all** nutrient management plans that include land application of manure or other organic by-products.

A Screening Tool may be used to determine if the Phosphorous Index needs to be documented for each field. If the screening tool indicates that manure or other organic by-products may be applied according to crop nitrogen requirements, document the field specific information used to make the initial determination including:

- soil test P
- extraction method
- sample depth
- reason why runoff and/or irrigation tail water cannot reach a surface water resource

Include this information in the plan to meet the risk assessment requirement.

### ***Phosphorus Risk Screening Tool***



## ***North Dakota Phosphorus Index***

### ***Purpose***

The purpose of North Dakota Phosphorus (P) Index is to assess the risk of P delivery to surface waters. The index is a tool for conservation planners, landowners/land users, and others to evaluate the current risk from P reaching surface water from a specific site, and to determine factors which dominate the risk due to P transport to surface waters. It will also assist landowners/land users in making management decisions to minimize the risk.

### ***Background***

Phosphorus is an important nutrient needed for crop production, and many fertilizers and organic sources can be used to supplement the supply of available P in soils. However, there are environmental concerns when excessive amounts of P (and other nutrients) from various sources reach surface waters. Phosphorus from soil, manure, fertilizer, and runoff, or subsurface flow that reaches surface water can produce eutrophication. Eutrophication is defined as an increase in the fertility status of natural waters that causes accelerated growth of algae or aquatic plants. In most fresh surface waters (lakes, ponds, and streams), the excessive growth of algae or aquatic plants is limited by inadequate levels of P. Large amounts of P to surface waters from nonpoint sources, such as agricultural fields, can elevate the P concentration in the water above critical levels for aquatic plant growth and enhance the development of eutrophication.

The challenge to producers and agriculturists is to develop a plan that efficiently utilizes all sources of nutrients, and at the same time, maintains or increases agricultural profitability and environmental quality.

The P index is an integrated approach to estimating the risk of P delivered to surface water from agricultural fields. The North Dakota Phosphorus Index is patterned after the index proposed by Lemunyon and Gilbert (1993) and has been modified for use in North Dakota. The P index integrates many soil and field characteristics that influence potential P movement to surface waters. These characteristics include source factors such as soil test P, rate, method and timing of P application (fertilizer, manure, and other organic sources), and erosion. They also include transport factors such as sediment delivery, soil conservation practices, and runoff. The P index provides a relative rating as to the risk of P moving from individual fields, which can be used to prioritize fields for nutrient and soil management practices. With the integrated system, the P index is useful for understanding the processes causing a high P delivery to surface water, and can help identify management practices to lower that risk. Ultimately, use of the P Index should minimize the risk of P delivered to surface water, improve or maintain water quality, and provide producers options for improved P management.

### ***Concepts of the North Dakota P Index***

The ranking of the P index identifies sites where the risk of P movement may be relatively higher than other sites. When parameters of the index are analyzed, it will become apparent that an individual parameter or parameters may be influencing the index disproportionately. These identified parameters can be the basis for planning corrective soil and water conservation practices and management techniques. If successful in reducing the movement of P, the concern of P enrichment will also be reduced. The P index will be a 7 x 5 matrix using a limited number of site and management characteristics. Input to the matrix will be readily accessible field data. This index will be used as a tool for understanding the contribution that individual site and management parameters have toward risk of P movement and will provide a method for developing management guidelines for P at the site to lessen impact on water quality.

### ***Procedures for Making an Assessment***

The P Index consists of five site and management risk factors that can affect the potential for the movement of P offsite. In order to complete an assessment, the relative risk associated with each of these five factors must be rated. The rating scale is from None (0), Low (1), Medium (2), High (3), to Very High (5). Instructions for rating each risk factor are provided below. The rating process will

require field-specific knowledge of soils and slopes, soil test P levels, crop rotation and yield history, soil erosion, and P application history and methods. Once the Risk Factors are rated, add the values together and compare the sum with the P Index Risk Interpretations to determine the relative potential for the P movement offsite. Implementation of Best Management Practices may also be considered in order to mitigate or decrease the relative risk potential.

#### ***Precautions in the Use of the P Index***

The P Index is an assessment tool to be used by planners and land users to assess the risk that exists for P leaving the landform site and travelling toward a water body. It also can be used to identify the critical parameters of soil, topography, and management that most influence the movement. Using these parameters, the P index then can help select management alternatives that would significantly address the potential impact and reduce the risk. The P index is part of the planning process that takes place between the land user and resource planner. It can be used to communicate the concept, process, and results expected if various alternatives are used in the management of the natural resources at the site.

**THE P INDEX IS NOT INTENDED TO BE AN EVALUATION SCALE FOR DETERMINING WHETHER LAND USERS ARE ABIDING WITHIN WATER QUALITY OR NUTRIENT MANAGEMENT STANDARDS THAT HAVE BEEN ESTABLISHED BY LOCAL, STATE, OR FEDERAL AGENCIES.**

Any attempt to use this P index as a regulatory scale would be grossly beyond the intent of the assessment tool, and the concept and philosophy of the working group that developed it. The P index should be adapted to local conditions by a process of regional adaptations of the site characteristic parameters. This development process must involve local and State agencies and resource groups that are concerned with the management of P. After the P index is adapted to a locality, it should be tested by the development group to assure that assessments are giving valid and reasonable results. Field testing of the P index is one of the most appropriate methods for assessing the value of the P index.

#### ***Use of the P Index in the Natural Resources Conservation Service***

The P index is a planning tool for use in resource management plans, for water and soil quality, nutrient management, and ecosystem-based planning assistance in watersheds. The P index should be used by the planner, to communicate to the land user, the potential risk for phosphorus movement on the landscape. The NRCS does not condone or promote the use of the P index for placing any restrictions on land use or regulatory purposes that could be construed by manipulating the parameters of the index.

North Dakota Phosphorus Index Risk Assessment (Version 1.0)						
Factor	None (0)	Low (1)	Medium (2)	High (3)	Very High (5)	Score
1. Soil Erosion	<2 tons/ac	2 - <5 tons/ac	5 - <10 tons/ac	10-15 tons/ac	> 15 tons/ac	
2. Runoff Potentials		Not Rated		Moderate	High	
3. Soil Test P (See Table 3)	Not applicable	Low	Medium	High	Very High	
4. P Application Rate (Annually applied or rotational average lbs. P <sub>2</sub> O <sub>5</sub> per acre per year, all sources)	None applied	<30	30-90	91-150	>150	
5. P Application Method (Use highest applicable risk category for multiple P applications)	None applied	Injected or subsurface application	Spring applied and incorporated within 2 weeks	Fall/winter applied and incorporated within 2 weeks	Surface applied with no incorporation, or fall/winter applied with spring incorporation	
6. Distance to Surface Water	>1000 feet	200-1000 feet	100 -<200 feet	20 -<100 feet	<20 feet	
Gross Score (sum of Factors 1 through 6)						
7. BMP Implementation Credits	Subtract 1 point for each of the BMPs implemented (circled) on this site. Cover or Green Manure Crops      Filter Strips Contour Buffer Strips              Established Notill System Maximum score is 2					
Net Score (sum of Factors 1 through 6 less Factor 7, BMP Implementation Credits)						

Score	Phosphorus Index Risk Interpretations
<b>&lt; 8</b>	This field has a <b>LOW</b> potential for off-site P movement if management is maintained at the current level. Organic nutrient application rates may be calculated according to crop nitrogen requirements.
<b>8 to 11</b>	This field has a <b>MEDIUM</b> potential for off-site P movement and some management changes may need to be made to support continued long term organic nutrient applications. Organic nutrient application rates may be calculated according to crop nitrogen requirements.
<b>12 to 15</b>	This field has a <b>HIGH</b> potential for off-site P movement and management changes should be implemented to decrease risk. Organic nutrient application rates should be calculated according to crop phosphorus requirements.
<b>16</b>	This field has a <b>VERY HIGH</b> potential for off-site P movement and management changes are needed to decrease risk. Organic nutrients should not be applied to this field.

## North Dakota Phosphorus Index Factors

### Factor 1. Soil Erosion

Soil erosion is defined as the loss of soil along the slope or unsheltered distance caused by the processes of water and wind. Soil erosion (wind, sheet and rill, and gully) is estimated from approved erosion prediction models. Erosion induced by irrigation is calculated by other approved methods. The value category is given in tons of soil loss per acre per year (ton/acre/year).

**Table 1.** Soil Erosion

Soil Erosion Class					
	None (0)	Low (1)	Medium (2)	High (3)	Very High (5)
Tons/ac	<2 tons/ac	2 - < 5 tons/ac	5 - <10 tons/ac	10-15 tons/ac	> 15 tons/ac

### Factor 2. Runoff Potentials

Runoff potentials are based on % field slope and the Kw for each soil. Potentials are determined to be high if Kw x upper % slope of the map unit is greater than 3 and moderate if greater than 2. Runoff potentials for specific soils for your area can be found in Section II of the Field Office Technical Guide. Contact your local NRCS field office for soil information.

**Table 2.** Runoff Potentials

Kw factor	Moderate Potential (3)		High Potential (5)	
	Slopes	Slope Group	Slopes	Slope Group
0.15	=>13%	9-15%	=>20%	15-25%
0.17	=>12%	9-15%	=>18%	15-25%
0.20	=>10%	9-15%	=>15%	15-25%
0.24	=>8%	6-9%	=>13%	9-15%
0.28	=>7%	6-9%	=>11%	9-15%
0.32	=>6%	6-9%	=>9%	9-15%
0.37	=>5%	3-6%	=>8%	6-9%
0.43	=>5%	3-6%	=>7%	6-9%

### Factor 3. Soil Test Phosphorus

Bray P1 soil tests are used for low pH soils. Olsen soil tests are used for soils with a pH greater than 7.0 that contain calcium carbonate. Mehlich 3 soil tests have been used for both low and high pH soils. Phosphorus soil test samples should be taken from the top 2 to 3 inches for continuous no-till cropland, hayland and pastures, and from the top 8 to 12 inches for tilled cropland.

**Table 3.** Soil Test Phosphorus Risk

Soil Test Extraction	Low (1)	Medium (2)	High (3)	Very High (5)
Bray P1	< 30 ppm	30-60 ppm	61-120 ppm	> 120 ppm
Mehlich 3	< 20 ppm	20-70 ppm	70-140 ppm	> 140 ppm
Olsen	< 20 ppm	20-40 ppm	41-80 ppm	> 80 ppm

**Factor 4. Phosphorus Application Rate**

The Phosphorus Application Rate is the amount of phosphorus ( $P_2O_5$ ) annually applied (or average annual application rate calculated for the current rotation) to the field in pounds per acre from both inorganic and organic sources. The pounds per acre of phosphorus, annually applied from organic sources, are derived from tons or gallons per acre applied and the nutrient content can be estimated from manure tests or book values. See NDSU Extension Service Bulletins or the USDA-NRCS Agricultural Waste Management Field Handbook for acceptable book values.

**Table 4.** Phosphorus Application Rate Risk

Phosphorus Application Rate Risk					
	None (0)	Low (1)	Medium (2)	High (3)	Very High (5)
Rate (lb. $P_2O_5$ /ac.)	None Applied	< 30	30-90	91-150	> 150

**Factor 5. Phosphorus Application Method**

The manner in which phosphorus is applied to the soil and the amount of time exposed on the soil surface impacts potential P losses. Injected or subsurface applied implies that the P is applied below the soil surface. Incorporated implies that the P is spread on the surface and then mixed into the soil to a depth of at least two inches. The categories of increasing severity, Low to Very High, indicate the longer surface exposure time between P application, incorporation, and crop utilization.

**Table 5.** Phosphorus Application Method Risk

Phosphorus Application Method					
	None (0)	Low (1)	Medium (2)	High (3)	Very High (5)
Application Method	None Applied	Injected or Subsurface Applied	Spring Applied and Incorporated within 2 weeks	Fall/Winter Applied and Incorporated within 2 weeks	Surface Applied with No Incorporation, or Fall/Winter Applied with Spring Incorporation

**Factor 6. Distance to Surface Water**

This category is an estimate of distance between the application site and the point where runoff water enters a defined channel. Use zero for distance, if manure is applied directly into a defined channel (eg. water ways, gullies, drainage courses or ditches) that delivers runoff water into intermittent or perennial streams, lakes, permanent or semi-permanent wetlands.

**Table 6.** Distance to Surface Water

Distance to Surface Water					
	None (0)	Low (1)	Medium (2)	High (3)	Very High (5)
Distance to Surface Water	>1000 feet	200-1000 feet	100 -<200 feet	20 -<100 feet	<20 feet

**Factor 7. Best Management Practice (BMP) Implementation Credits**

Specific BMPs may be implemented to decrease the relative potential for offsite P movement. To take a BMP credit, subtract one point from the gross score for each of the following BMPs implemented onsite.

- ◆ **Cover or Green Manure Crops** may be planted after harvest or crop failure to decrease erosion potential and use excess nutrients applied to the field.
  - ◆ **Filter Strips** may be planted on the down gradient side of the field to decrease the potential to transport phosphorus offsite.
  - ◆ **Contour Buffer Strips** of permanent vegetation may be planted on the contour and alternated with wider cultivated strips to slow runoff and trap sediment.
  - ◆ **Established Notill System** consisting of a minimum of 3 crop years of production using practices that meet conservation practice 329a Residue Management-Notill and Striptill.
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EXAMPLE

North Dakota Phosphorus Index Risk Assessment (Version 1.0)						
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1. Soil Erosion	<2 tons/ac	2 - <5 tons/ac	5 - <10 tons/ac	10-15 tons/ac	> 15 tons/ac	2
2. Runoff Limitations		Not Rated		Moderate	High	1
3. Soil Test P (See Table 3)	Not applicable	Low	Medium	High	Very High	3
4. P Application Rate (Annually applied or rotational average lbs. P <sub>2</sub> O <sub>5</sub> per acre per year, all sources)	None applied	<30	30-90	91-150	>150	2
5. P Application Method (Use highest applicable risk category for multiple P applications)	None applied	Injected or subsurface application	Spring applied and incorporated within 2 weeks	Fall/winter applied and incorporated within 2 weeks	Surface applied with no incorporation, or fall/winter applied with spring incorporation	3
6. Distance to Surface Water	>1000 feet	200-1000 feet	100 -<200 feet	20 -<100 feet	<20 feet	5
Gross Score (sum of Factors 1 through 6)						16
7. BMP Implementation Credits	Subtract 1 point for each of the BMPs implemented (circled) on this site. Cover or Green Manure Crops      Filter Strips Contour Buffer Strips                  Established Notill System Maximum score is 2					2
Net Score (sum of Factors 1 through 6 less Factor 7, BMP Implementation Credits)						14

Score	Phosphorus Index Risk Interpretations
<b>&lt; 8</b>	This field has a <b>LOW</b> potential for off-site P movement if management is maintained at the current level. Organic nutrient application rates may be calculated according to crop nitrogen requirements.
<b>8 to 11</b>	This field has a <b>MEDIUM</b> potential for off-site P movement and some management changes may need to be made to support continued long term organic nutrient applications. Organic nutrient application rates may be calculated according to crop nitrogen requirements.
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